Claims

1. A method of producing a population of at least ten cells, wherein at least 30% of said cells are multipotent stem cells or progeny thereof and wherein said multipotent stem cells are substantially purified from a hair follicle or a dermal papilla-containing portion thereof, said method comprising the steps of:

(a) providing a hair follicle or a dermal papilla-containing portion thereof from a mammal;

(b) culturing said hair follicle or said portion in conditions under which multipotent stem cells grow and proliferate non-adherently and at least 25% of the cells that are not multipotent stem cells die or adhere to the culture substrate; and

(c) separating non-adherent cells from adherent cells and collecting non-adherent cells; and

(d) continuing culture step (b) and (c) until at least 30% of collected cells are multipotent stem cells or progeny of said multipotent stem cells.

2. The method of claim 1, wherein said step (a) further comprises dissociating said hair follicle or said portion into smaller pieces by mechanical or enzymatic disruption.

3. A method of inducing hair growth in a mammal by providing to said mammal a population of cells, wherein at least 30% of said cells are multipotent stem cells or progeny thereof and wherein said multipotent stem cells are substantially purified from a hair follicle or a dermal papilla-containing portion thereof and are capable of producing hair follicle cells.

4. A method of inducing hair growth in a mammal by providing to said mammal a population of cells, wherein at least 30% of said cells are hair follicle cells that

have differentiated from multipotent stem cells substantially purified from the dermal papillae of a hair follicle.

5. The method of any one of claims 1, 3, or 4, wherein at least 80% of the cells are multipotent stem cells substantially purified from said hair follicle or dermal papilla-containing portion thereof.

6. The method of claim 5, wherein at least 90% of the cells are multipotent stem cells substantially purified from said hair follicle or dermal papilla-containing portion thereof.

7. The method of claim 6, wherein at least 95% of the cells are multipotent stem cells substantially purified from said hair follicle or dermal papilla-containing portion thereof.

8. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cells express at least one protein selected from the group consisting of nestin, WNT-1, vimentin, fibronectin, S100, slug, snail, twist, Pax3, Sox9, Dermo, and SHOX2.

9. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cells do not express measurable levels of p75NTR.

10. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cells do not express measurable levels of at least one protein selected from the group consisting of tyrosinase, c-kit, tryp1, DCT, MBP, P0, and SOX10.

11. The method of any one of claims 1, 3, or 4, wherein said hair follicle is from an adult mammal.

12. The method of claim 9, wherein said hair follicle is from a juvenile mammal.

13. The method of any one of claims 1, 3, or 4, wherein said mammal is a human.

14. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cells comprise cells that can differentiate into hair follicles cell under appropriate conditions.

15. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cells comprise cells that can differentiate into neurons, astrocytes, Schwann cells, or oligodendrocytes under appropriate conditions.

16. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cells comprise cells that can differentiate into non-neural cells.

17. The method of claim 14, wherein said non-neural cells are smooth muscle cells or adipocytes.

18. The method of any one of claims 1, 3, or 4, wherein said multipotent stem cell contains a heterologous gene in an expressible genetic construct.

19. The method of claim 16, wherein said gene encodes a therapeutic protein.

20. The method of claim 17, wherein said gene encodes a protein which induces or facilitates differentiation of said stem cell.

21. The method of claim 3 or 4, wherein said multipotent stem cells are obtained using the method of claim 1.

22. The method of 3 or 4, wherein said multipotent stem cells are from said mammal.

23. The method of claim 3 or 4, wherein said stem cells are from a donor mammal that is immunologically similar to said mammal.

24. The method of claim 3 or 4, wherein said mammal has a condition characterized by a reduced amount of hair.

25. The method of claim 24, wherein said condition is the result of alopecia, accidental injury, damage to hair follicles, surgical trauma, a burn wound, radiation therapy, chemotherapy, an incisional wound, or a donor site wound from skin transplant.

26. A kit comprising multipotent stem cells capable of inducing hair growth in a mammal and instructions for inducing hair growth in a mammal.

27. The kit of claim 26, wherein said stem cells are substantially purified from hair follicles or dermal papilla-containing portions thereof.

28. The kit of claim 26, wherein said multipotent stem cells express at least one protein selected from the group consisting of nestin, WNT-1, vimentin, fibronectin, S100, slug, snail, twist, Pax3, Sox9, Dermo, and SHOX2.

29. The kit of claim 26, wherein said multipotent stem cells do not express measurable levels of p75NTR.

30. The kit of claim 26, wherein said multipotent stem cells do not express measurable levels of at least one protein selected from the group consisting of tyrosinase, c-kit, tryp1, DCT, MBP, P0, and SOX10.

31. The kit of claim 26, wherein said mammal has a condition characterized by a reduced amount of hair.

32. The kit of claim 26, wherein said condition is the result of alopecia, accidental injury, damage to hair follicles, surgical trauma, a burn wound, radiation therapy, chemotherapy, an incisional wound, or a donor site wound from skin transplant.

33. The kit of claim 26, wherein said mammal is a human.

34. A kit comprising multipotent stem cells capable of regenerating skin in a mammal and instructions for regenerating skin in a mammal.

35. The kit of claim 34, wherein said stem cells are substantially purified from hair follicles or dermal papilla-containing portions thereof.

36. The kit of claim 34, wherein said multipotent stem cells express at least one protein selected from the group consisting of nestin, WNT-1, vimentin, fibronectin, S100, slug, snail, twist, Pax3, Sox9, Dermo, and SHOX2.

37. The kit of claim 34, wherein said multipotent stem cells do not express measurable levels of p75NTR.

38. The kit of claim 34, wherein said multipotent stem cells do not express measurable levels of at least one protein selected from the group consisting of tyrosinase, c-kit, tryp1, DCT, MBP, P0, and SOX10.

39. The kit of claim 34, wherein said mammal has a condition characterized by a reduced amount of hair.

40. The kit of claim 40, wherein said condition is the result of alopecia, accidental injury, damage to hair follicles, surgical trauma, a burn wound, radiation therapy, chemotherapy, an incisional wound, or a donor site wound from skin transplant.

41. The kit of claim 34, wherein said mammal is a human.

42. A method of inducing hair growth in a mammal by providing to said mammal a population of cells, wherein at least 30% of said cells are multipotent stem cells or progeny thereof and are capable of producing hair follicle cells.

43. The method of claim 42, wherein at least 80% of the cells are multipotent stem cells or progeny thereof and are capable of producing hair follicle cells.

44. The method of claim 43, wherein at least 90% of the cells are multipotent stem cells or progeny thereof and are capable of producing hair follicle cells.

45. The method of claim 44, wherein at least 95% of the cells are multipotent stem cells or progeny thereof and are capable of producing hair follicle cells.

46. The method of claim 42, wherein said stem cells are substantially purified from hair follicles or dermal papilla-containing portions thereof.

47. The method of claim 42, wherein said multipotent stem cells express at least one protein selected from the group consisting of nestin, WNT-1, vimentin, fibronectin, S100, slug, snail, twist, Pax3, Sox9, Dermo, and SHOX2.

48. The method of claim 42, wherein said multipotent stem cells do not express measurable levels of p75NTR.

49. The method of claim 42, wherein said multipotent stem cells do not express measurable levels of at least one protein selected from the group consisting of tyrosinase, c-kit, tryp1, DCT, MBP, P0, and SOX10.

50. The method of claim 42, wherein said mammal has a condition characterized by a reduced amount of hair.

51. The method of claim 50, wherein said condition is the result of alopecia, accidental injury, damage to hair follicles, surgical trauma, a burn wound, radiation therapy, chemotherapy, an incisional wound, or a donor site wound from skin transplant.

52. The method of claim 42, wherein said cells are from said mammal.

53. A method of regenerating skin in a mammal by providing to said mammal a population of cells, wherein at least 30% of said cells are multipotent stem cells or progeny thereof and are capable of regenerating skin.

54. The method of claim 53, wherein at least 80% of the cells are multipotent stem cells or progeny thereof and are capable of regenerating skin.

55. The method of claim 54, wherein at least 90% of the cells are are multipotent stem cells or progeny thereof and are capable of regenerating skin.

56. The method of claim 55, wherein at least 95% of the cells are multipotent stem cells or progeny thereof and are capable of regenerating skin.

57. The method of claim 53, wherein said stem cells are substantially purified from hair follicles or dermal papilla-containing portions thereof.

58. The method of claim 53, wherein said multipotent stem cells express at least one protein selected from the group consisting of nestin, WNT-1, vimentin, fibronectin, S100, slug, snail, twist, Pax3, Sox9, Dermo, and SHOX2.

59. The method of claim 53, wherein said multipotent stem cells do not express measurable levels of p75NTR.

60. The method of claim 53, wherein said multipotent stem cells do not express measurable levels of at least one protein selected from the group consisting of tyrosinase, c-kit, tryp1, DCT, MBP, P0, and SOX10.

61. The method of claim 53, wherein said mammal has a condition characterized by a damaged skin.

62. The method of claim 61, wherein said condition is the result of accidental injury, surgical trauma, a burn wound, an incisional wound, or a donor site wound from skin transplant.

63. The method of claim 53, wherein said cells are from said mammal.

64. A method of making hair follicles, said method comprising culturing multipotent stem cells under conditions that induce said stem cells to differentiate into hair follicles.

65. The method of claim 53, wherein said stem cells are substantially purified from hair follicles or dermal papilla-containing portions thereof.

66. The method of claim 53, wherein said multipotent stem cells express at least one protein selected from the group consisting of nestin, WNT-1, vimentin, fibronectin, S100, slug, snail, twist, Pax3, Sox9, Dermo, and SHOX2.

67. The method of claim 53, wherein said multipotent stem cells do not express measurable levels of p75NTR.

68. The method of claim 53, wherein said multipotent stem cells do not express measurable levels of at least one protein selected from the group consisting of tyrosinase, c-kit, tryp1, DCT, MBP, P0, and SOX10.